Process Modeling and Life Cycle Assessment of Biomass Conversion

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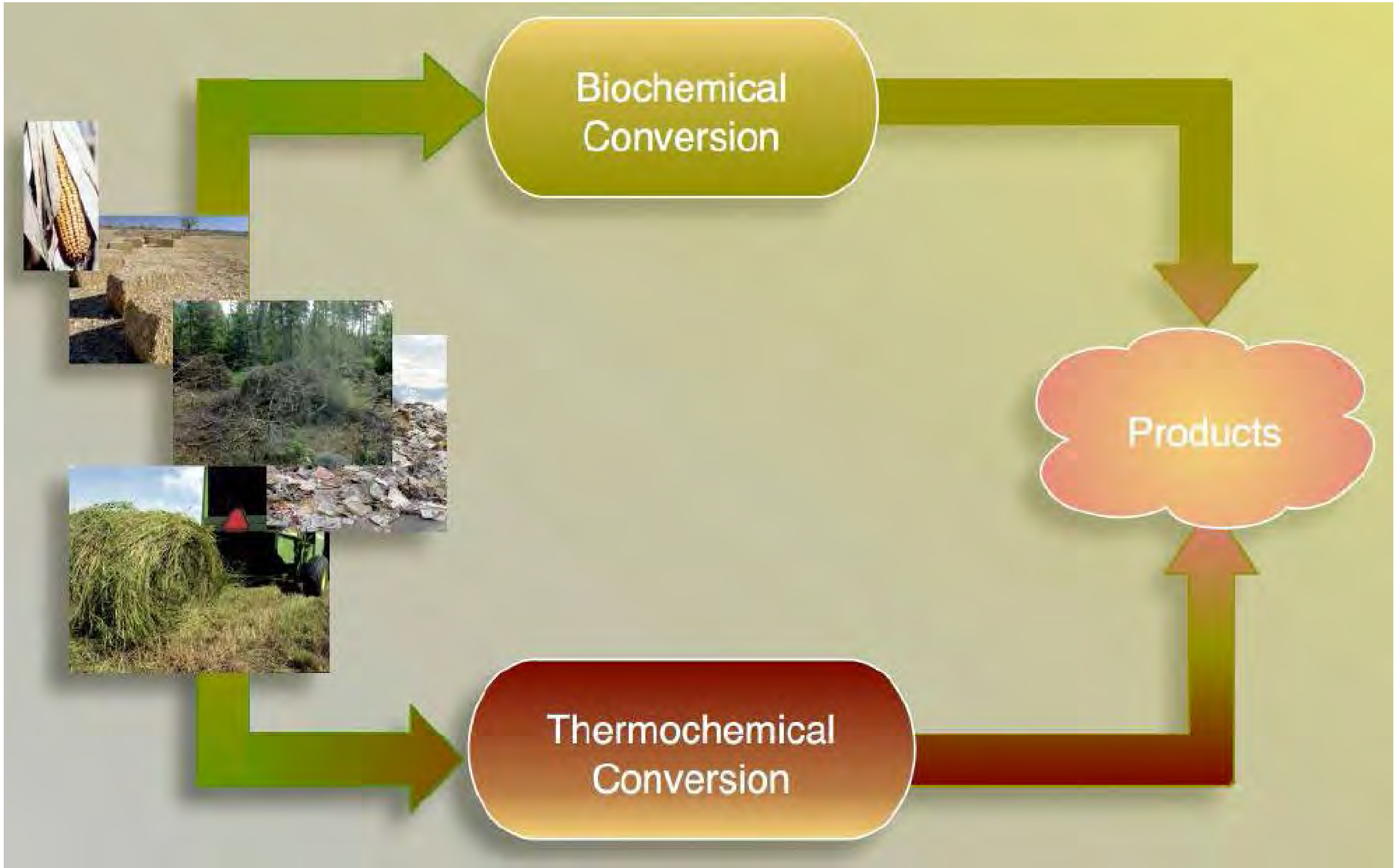
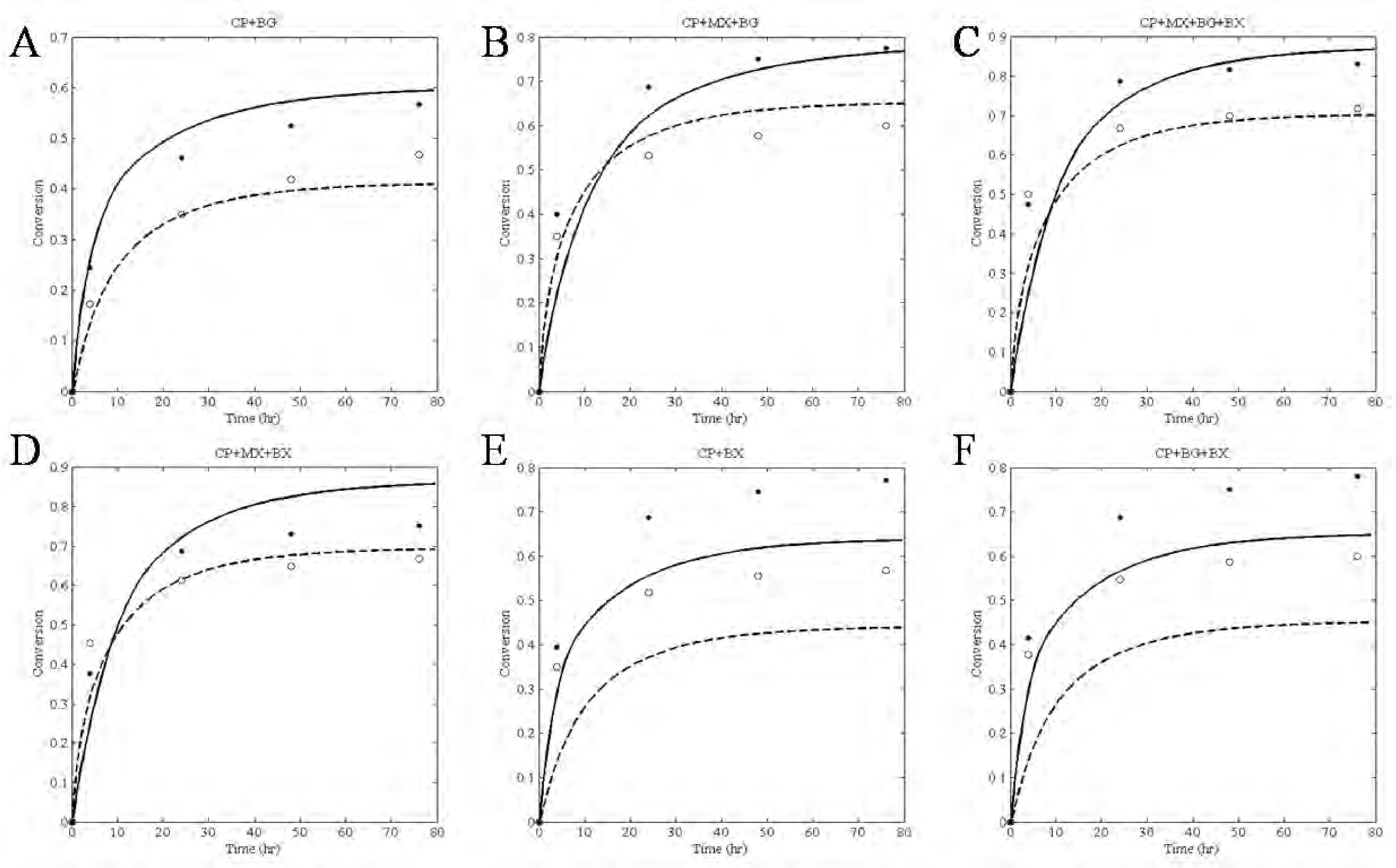
October 12, 2017

Conversion Pathways



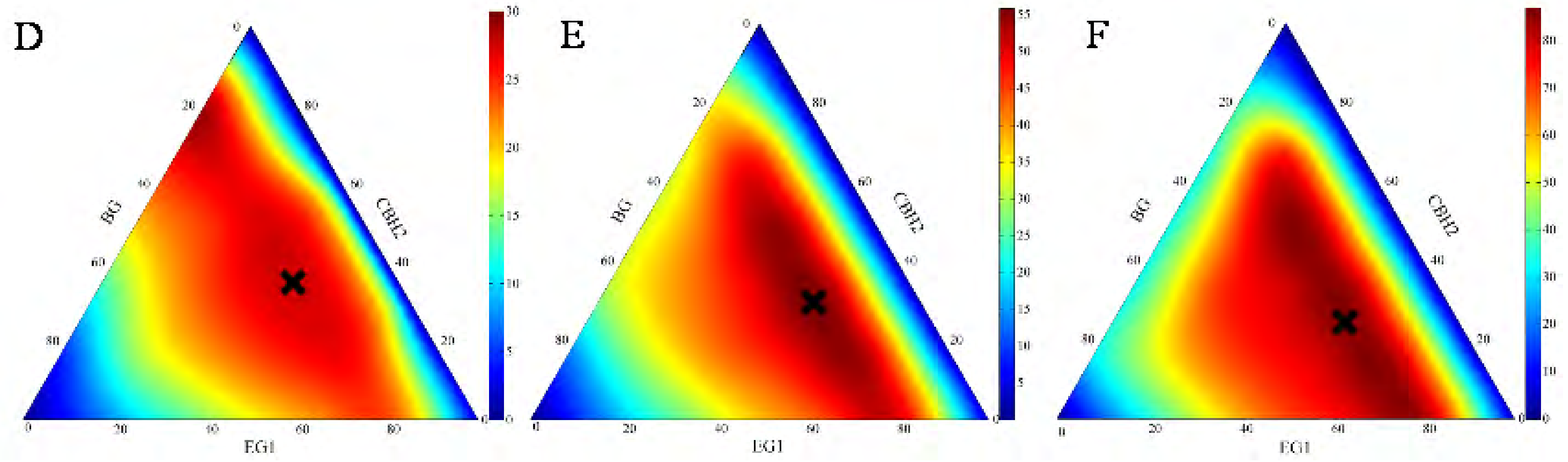
Hemicellulose-Cellulosic Substrate



Comparison with experimental data from Qing and Wyman (2011)

Optimal Enzyme Mixture Composition

72 Hr Hydrolysis of Cellulose for Max Glucose Yield



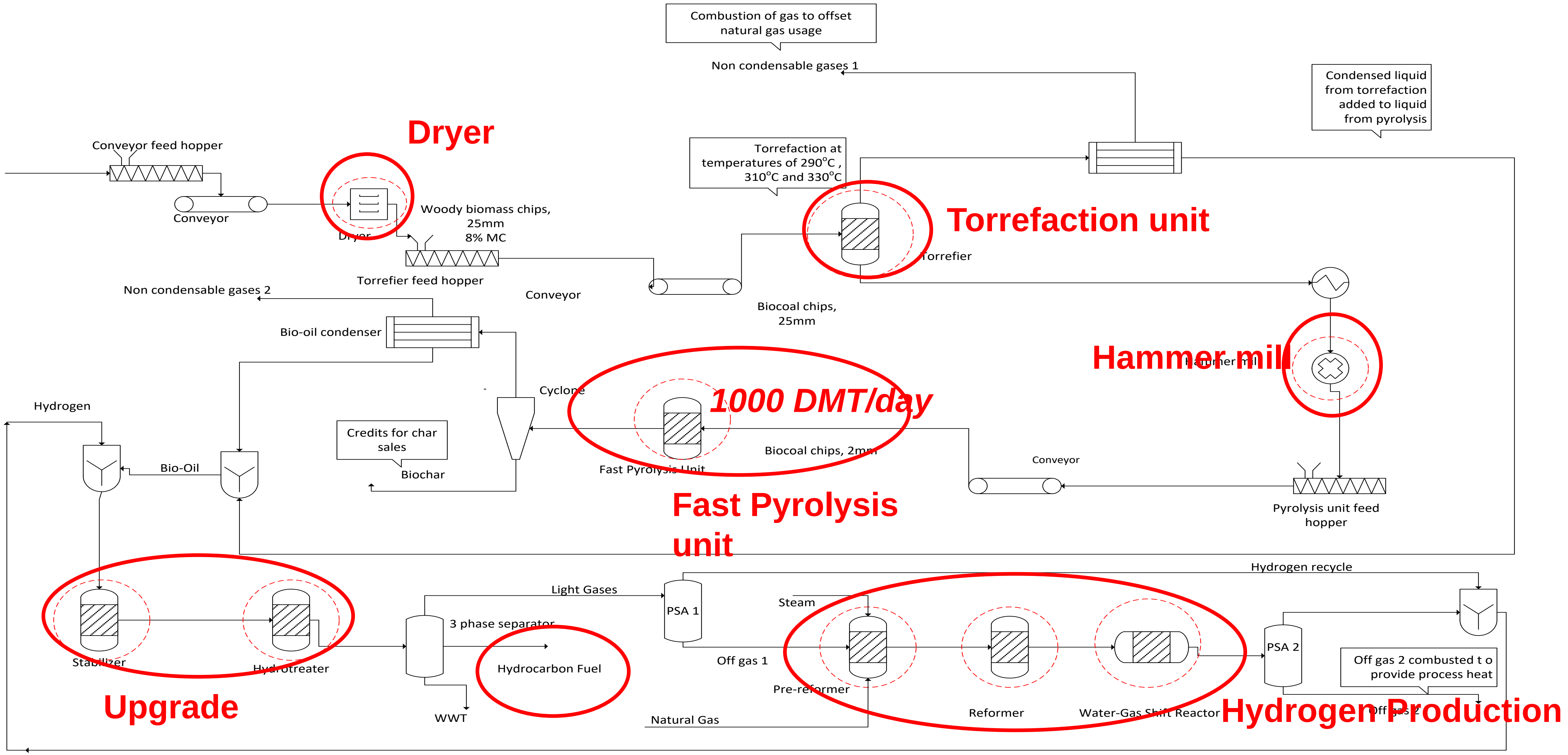
Enzyme (mg/g glucan)	EG1	CBH1	CBH2	EX	BG	BX	Glucose Yield
7.5	0.38	0.00	0.38	0	0.24	0	27.5%
15	0.46	0.00	0.32	0	0.22	0	52.6%
30	0.52	0.00	0.24	0	0.24	0	81.0%

Thermochemical Conversions

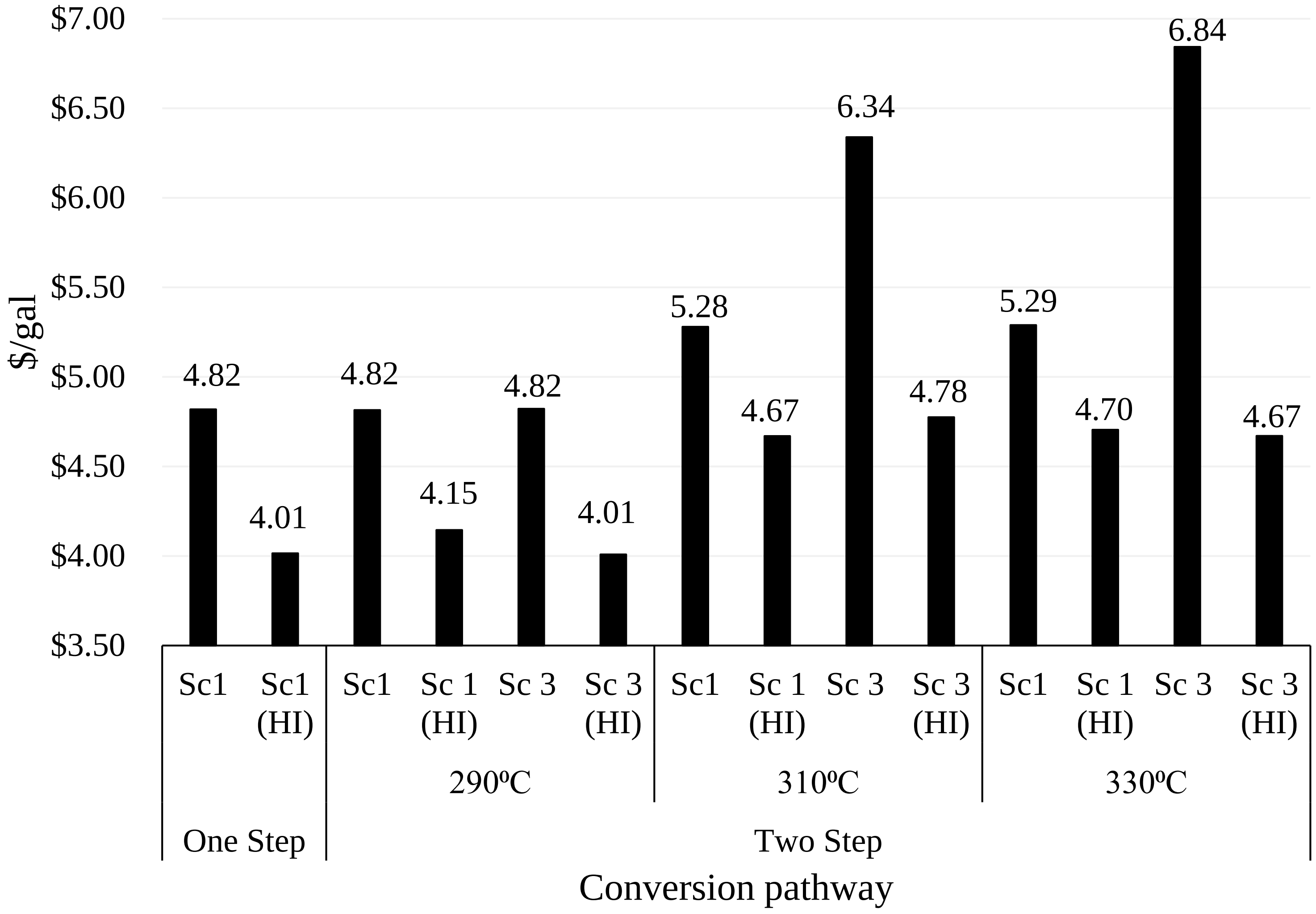
Torrefaction	Fast Pyrolysis
200 – 300 °C	400 – 600 °C
20 – 30 mins.	1 sec.
O_2-free	O_2-free
Primarily solid bio-coal	Primarily viscous bio-oil
Pyrolysis feedstock	Hydrocarbon biofuels Feedstock
70 – 90 wt% yield	60 – 80 wt% yield

Process Description

Simplified schematic diagram for a two step pyrolysis system

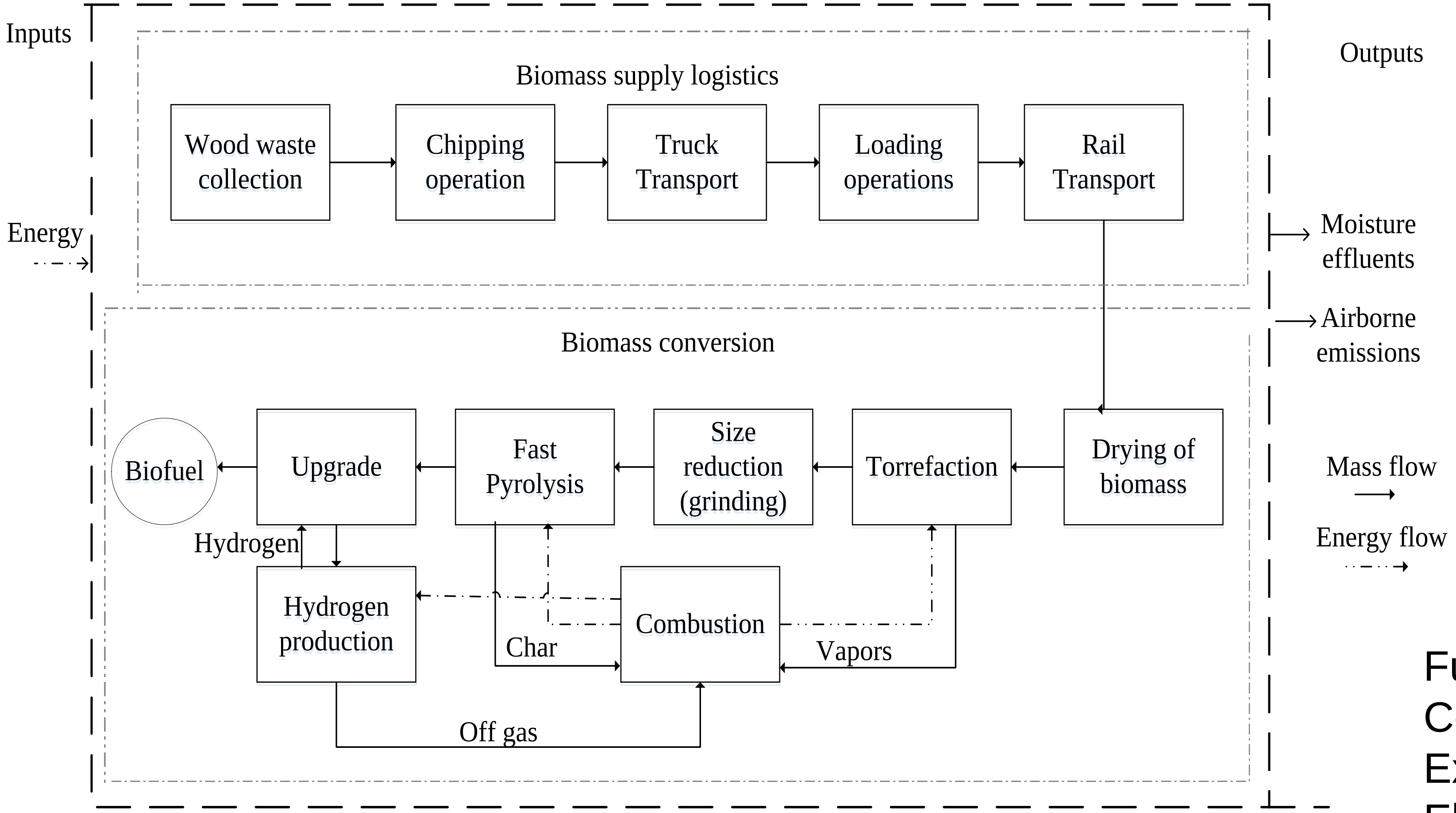


Cost of production of hydrocarbon fuel (with heat integration)



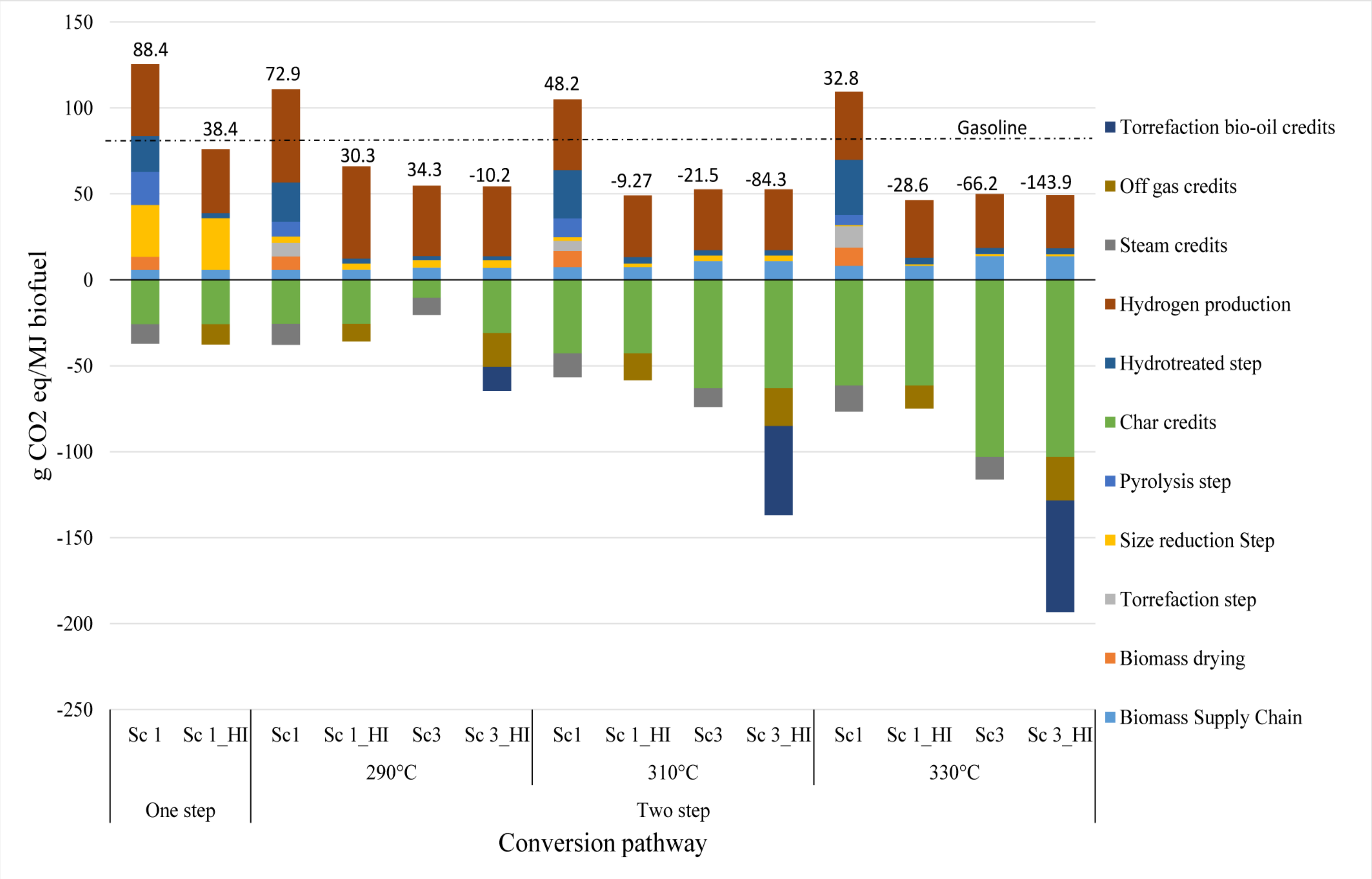
Further reduction in cost of production observed with heat integration

Life Cycle Assessment: Carbon Footprint Cradle to grave system boundary



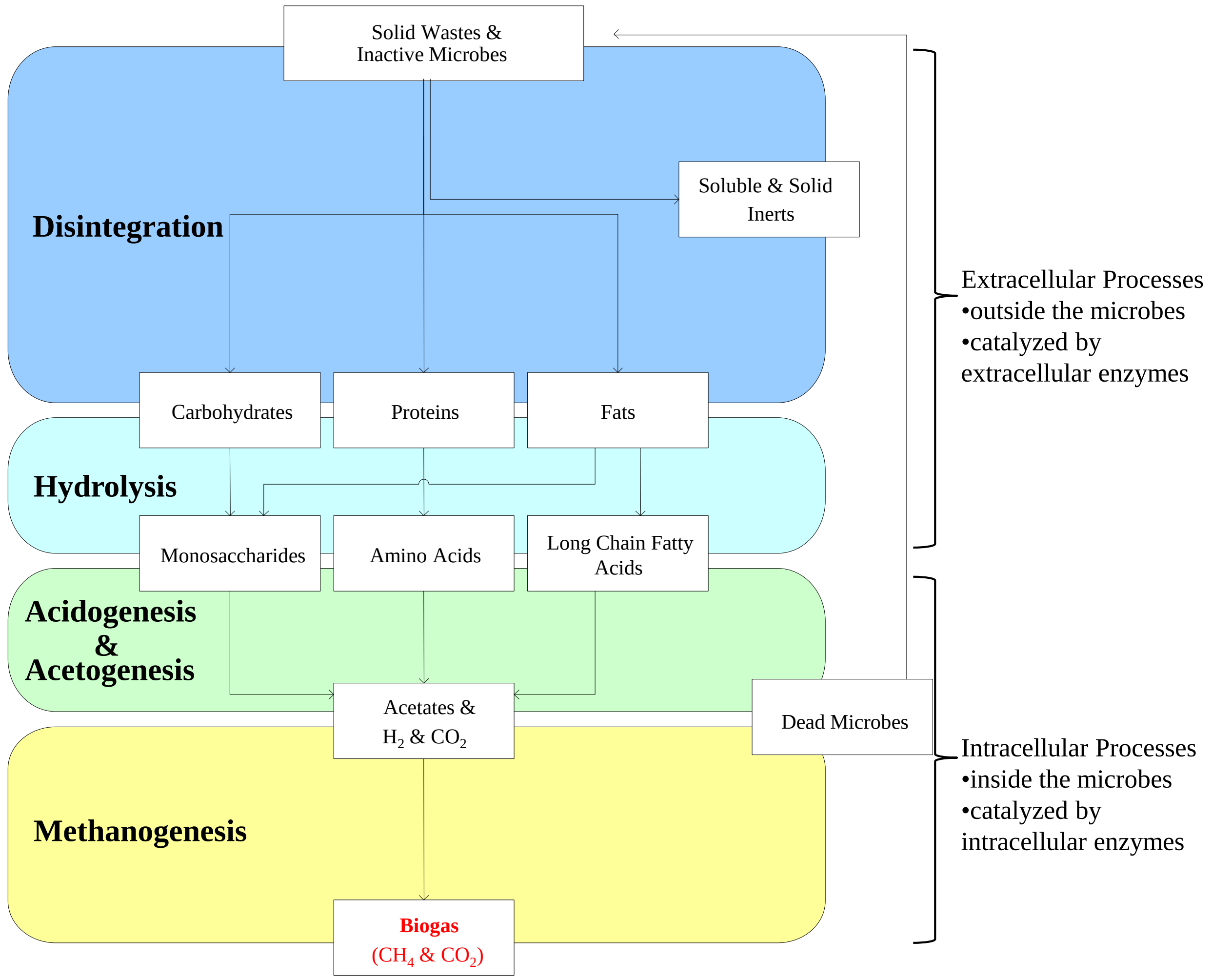
Functional unit: 1 MJ of biofuel
Co-Product Allocation: System Expansion
Electricity from US grid

LCA: GHG Emission with heat integration



Anaerobic Digestion of Food and Industrial Wastes

Bio-chemical process system



Physico-chemical process system

- Not directly mediated by microbes
- Major processes
  - Liquid-gas processes

  (i.e. liquid-gas transfer)
  - Liquid-liquid processes

  (i.e. ion association/dissociation)
  - Liquid-solid processes

  (i.e. precipitation/solubilization)
- Simultaneously occur with biochemical processes
- Affect other processes of anaerobic digestion

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